MINERALOGY OF THE SOIL CLAY FRACTION AS AFFECTING PESTICIDE ADSORPTION-SOIL PROPERTIES RELATIONSHIPS

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Much work has been devoted to relate the adsorption of pesticides and the soils or sediments properties considering clay fraction and organic mattter as the most important variables. In these studies usually the diversity of the chemical nature of the surfaces present in clay fraction and organic matter were not allowed for. Recently the importance of the constituents of the various soil particle size fractions in pesticide sorption has been pointed out (Van Bladel and Moreale, 1982, Sanchez Camazano and Sanchez Martin, 1982, Huang et al. 1984, Weber et al. 1986, Hermosin et al. 1987). This comunication presents a study of the relationships between the adsorption capacity of the 22 soils for two pesticides (a non-ionic plant growth regulator: maleic hydrazide(MH) and a cationic acaricide: chlordimeform (CF)) and several selected soil properties, considering especially the influence of the soil clay mineralogy.

The Kf values, derived from Freundlich equation, were used as a measure of the relative adsorption capacity for the 22 soils and both pesticides. The relationships between Kf values and several selected properties were studied by obtaining simple correlation coefficients in two ways: a) Including all soils together and b)Grouping the soils according to their clay mineralogy: 1)Soils with phyllosilicates as essential clay components and Fef<5% and 2)Soils with iron oxides and oxihydroxides as major clay mineral components and thus Fef>5%. The results of these correlations are summarized in Table 1.

TABLE 1. Simple correlation coefficients (r) between Kf values and selected soil properties for maleic hydrazide (MH) and chlordimeform (CF) adsorption.

	Kf	Clay	O.M.	CEC	S_{BET}	pH	Fef
MH	All soils	0.86^{++++}	0.22	0.68^{++++}	0.89^{++++}	0.80^{++++}	-0.44
	Soils of Fef<5%	0.93^{++++}	0.24	0.71^{++}	0.91^{++++}	0.69^{++}	-0.93^{++++}
	Soils of Fef>5%	0.15	0.22	0.08	0.53^{+}	0.90^{++++}	0.11
CF	All soils	0.84^{++++}	0.04	0.79^{++++}	0.78^{++++}	0.67^{+++}	-0.68^{+++}
	Soils of Fef<5%	0.76^{+++}	0.21	0.69^{++}	0.75^{+++}	0.74^{+++}	-0.89^{++++}
	Soils of Fef>5%	0.03	0.34	0.83^{++++}	0.11	0.43	-0.68^{++}

$^{++++}$P 0.001, $^{+++}$0.001 P 0.01, $^{++}$0.01 P 0.05, $^{+}$0.05 P 0.1

Considering the 22 soils altogether, the results of the correlation showed that pesticide adsorption capacity were close related to clay content, specific surface area (S_{BET}), CEC and pH. However, the last two factors affected the pesticide adsorption at different levels: pH was closer related to MH and CEC did to CF adsorption, as a consequence of their non-ionic (very weak acid) and cationic character respectively. For CF adsrption a less significant correlation was found with free iron content (Fef) of the soils.

Considering only the 11 soils whose clay mineral components were essentially phyllosisicates and Fef<5% (soil of permanent charge)the correlation results (Table 1) were slightly different. The clay content, S_{BET}, CEC and pH were again the soil factors related to pesticide adsorption capacity, but these correlations were higher for MH and lower for CF adsorption than those found for all soils respectively. For both pesticides a very high correlation appeared with Fef which was inversely related to pesticide adsorption capacity. This was probably because of the fact that Fef represents, in these soils, iron oxides and oxihydroxides of low crystallinity that usually are coating the surface of the major clay components such as phyllosilicates, whose adsorption capacity is thus decreased.

For the other 11 soils whose clay fraction contains iron oxides and oxihydroxides as major or essential clay components and thus Fef>5% (soils of variable charge), the correlation results were quite different from those obtained for the above considered groups (Table 1). For each pesticide an only soil factor resulted close related to the adsorption capacity: the pH for MH adsorption and the CEC for CF adsorption. In this instance, the soil factor determining adsorption capacity had connection with the chemical character of the pesticide.

It is worth to note that in any case the adsorption of pesticide was not related to the organic matter content of the soils. Also, for both pesticides the nf parameter of the corresponding Freundlich equation showed the same correlation trend than that of Kf values.

These results showed that it should be very useful to consider the clay mineralogy when pesticide-soil or -sediment interaction is studied.

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